Document Cover Sheet

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Abstract

Panasonic, as Manufacturer, states that S/N method is more beneficial than "Noise A-Weighted" method for the product productivity, designing point of view and user experience.

We would like to offer consideration on S/N measurement method and the limit value >40dB at Signal to Highest SFI Ratio.

Panasonic cannot comment on the "Noise A-Weighted" method that is only a theoretical procedure.

Please note:

1. Subjective evaluation collected by persons who use hearing aids to compare and evaluate sounds of several samples from each manufactures.

2. Objective evaluation is based on the measurement results from the TR41.3 draft PN-3-0219 (TIA1083).

The limit of the draft PN-3-0219 (TIA1083） is defined by "Noise A-Weighted" value.

The limit value: < -40 dB (A/m) at Noise A-Weighted

This limit is based on subjective and objective evaluations by SHHH associations and TR41.3 round robin testing

S/N method means "Signal to Highest SFI Ratio".

* [Signal to Highest SFI Ratio]: dB difference between AFI and Highest SFI.

Values that are defined by S/N method are as follows;

Table 1: SHHH subjective rating data (Average of T-coil measurement)

Table 2: Objective measurement data (TR41.3 Round Robin Lab Testing)

				4 is better	5 is best	0 is best	1 is best	Purchase		
				(1 to 7)	(1 to 5)	(0 to 5)	(1 to 4)			
Brand	Model	Freq.	System	Loudness	%words	Interference	Usability	Yes	No	
Mic mode(Average of 5 data)										
Panasonic	KX-TG5050	5.8GHz	FHSS	3.40	3.60	1.20	2.20	3	2	60%
Panasonic (HA Off)	KX-TG2386B	2.4GHz	FHSS	4.00	4.80	1.00	1.40	3	2	60%
Panasonic (HA On)	KX-TG2386B	2.4GHz	FHSS	3.80	4.80	0.80	1.60	3	2	60%
Uniden	CLX 485	5.8GHz	DSSS	3.80	4.00	0.20	2.00	4	1	80%
Uniden	TRU 8860	5.8GHz	DSSS	3.60	3.40	0.20	2.60	4	1	80%
Uniden (A)	ELT 560	5.8GHz	DSSS	3.60	4.00	0.60	1.80	4	1	80%
Vtech	V2651	2.4GHz	FHSS	3.20	3.60	0.80	2.00	4	1	80%
Vtech (2)	Prototype 2	Prototype 2	Prototype 2	3.80	4.20	1.00	2.00	3	2	60%
Wireline	Wireline	Wireline	Wireline	4.00	4.40	0.80	1.20	4	1	80%
T-coil mode(Average of 27 data)										
Panasonic	KX-TG5050	5.8GHz	FHSS	3.67	3.26	2.93	2.78	6	21	22%
Panasonic (HA Off)	KX-TG2386B	2.4GHz	FHSS	3.81	3.26	2.52	2.59	10	17	37%
Panasonic (HA On)	KX-TG2386B	2.4GHz	FHSS	3.96	3.74	1.41	2.04	16	11	59%
Uniden	CLX 485	5.8GHz	DSSS	2.78	2.26	3.81	3.44	1	26	4%
Uniden	TRU 8860	5.8GHz	DSSS	2.96	2.78	2.30	2.93	10	17	37%
Uniden (A)	ELT 560	5.8GHz	DSSS	3.56	3.67	0.26	2.00	26	1	96%
Vtech	V2651	2.4GHz	FHSS	2.70	2.33	3.41	3.30	2	25	7%
Vtech (2)	Prototype 2	Prototype 2	Prototype 2	3.41	3.37	1.48	2.07	17	10	63%
Wireline	Wireline	Wireline	Wireline	3.89	4.19	0.07	1.48	27	0	100%

Table 1 :SHHH Subjective Data (Average)

		Noise A-wtd	Signal Quality	Highest SFI	Magnetic SFI	Signal (AFI) to Highest SFI Ratio	Field Intensity (AFI) 1kHz)
HAC2500	Uniden	-62.3	49.6	-76.5	14.3	63.9	-12.7
Volume 1	Vtech	-62.3	49.0	-69.6	7.2	56.2	-13.3
	AST	-76.2	64.8	-82.7	6.5	71.2	-11.4
	Average	-66.9	54.5	-76.3	9.3	63.8	-12.5
	Max-Min (dB)	13.9	15.8	13.1	7.8	15.0	1.9
Panasonic	Uniden	-31.8	27.8	-39.9	8.1	35.9	-4.0
KX-TG2386 B Telecoil OFF	Vtech	-28.9	25.6	-38.9	10.0	35.5	-3.3
Volume 1	AST	-28.7	25.3	-36.8	8.0	33.3	-3.4
	Average	-29.8	26.2	-38.5	8.7	34.9	-3.6
	Max-Min (dB)	3.1	2.5	3.1	1.9	2.5	0.7
Panasonic	Uniden	-50.6	46.9	-62.3	11.7	58.6	-4.0
KX-TG2386 B Telecoil On	Vtech	-44.1	40.1	-55.8	11.7	51.9	-4.0
Volume 1	AST	-53.2	49.9	-58.6	5.4	55.3	-3.3
	Average	-49.3	45.6	-58.9	9.6	55.2	-3.7
	Max-Min (dB)	9.1	9.8	6.5	6.4	6.7	0.7
Panasonic	Uniden	-31.0	28.1	-40.7	9.7	37.8	-2.9
KX-TG5050	Vtech	-29.6	26.9	-39.6	9.9	36.8	-2.8
Volume 1	AST	-30.1	28.7	-39.7	9.6	38.3	-1.4
	Average	-30.3	27.9	-40.0	9.7	37.6	-2.4
	Max-Min (dB)	1.4	1.9	1.1	0.4	1.5	1.5
Uniden	Uniden	-32.8	25.1	-36.2	3.4	28.5	-7.7
CLX485	Vtech	-34.8	24.3	-37.8	3.1	27.4	-10.4
Volume 1	AST	-29.4	20.6	-32.9	3.5	24.0	-8.8
	Average	-32.3	23.4	-35.6	3.3	26.6	-9.0
	Max-Min (dB)	5.3	4.6	4.9	0.4	4.5	2.7
Uniden	Uniden	-54.8	48.1	-62.9	8.2	56.3	-6.6
ETL560	Vtech	-54.7	48.3	-63.6	8.9	57.2	-6.4
Volume 1	AST	-61.3	57.1	-67.5	6.2	63.3	-4.2
	Average	-56.9	51.2	-64.7	7.7	58.9	-5.7
	Max-Min (dB)	6.6	9.0	4.6	2.7	7.0	2.4
Uniden	Uniden	-33.0	17.0	-36.8	3.8	20.8	-16.0
TRU8860	Vtech	-34.1	18.4	-37.7	3.6	21.9	-15.7
Volume 1	AST	-32.3	18.4	-35.9	3.6	22.0	-13.9
	Average	-33.1	17.9	-36.8	3.7	21.6	-15.2
	Max-Min (dB)	1.7	1.4	1.7	0.2	1.2	2.0
Vtech	Uniden	-38.9	28.6	-48.3	9.5	38.0	-10.3
VT2651	Vtech	-39.5	27.3	-47.2	7.7	35.0	-12.2
Volume 1	AST	-38.7	30.1	-47.4	8.7	38.8	-8.6
	Average	-39.0	28.6	-47.6	8.6	37.3	-10.4
	Max-Min (dB)	0.8	2.8	1.1	1.8	3.8	3.7
Vtech	Uniden	-49.7	46.4	-59.6	9.9	56.3	-3.3
Proto#2	Vtech	-49.8	49.5	-54.3	4.5	54.0	-0.3
Volume 1	AST	-50.1	47.5	-53.2	3.1	50.6	-2.6
	Average	-49.8	47.8	-55.7	5.8	53.6	-2.1
	Max-Min (dB)	0.4	3.1	6.4	6.8	5.7	3.0

Table 2: Objective Data RR (TR41.3 Lab Test Testing)

PNA comments on TIA (Draft) ： PN-3-0219 (TIA1083）

- The correlation coefficient between Subjective evaluation [Interference] and Objective measurement [Noise A-Weighted] is [r = 0.61], [PNA: r^2 = 0.79]

- The correlation coefficient between Subjective evaluation [Interference] and Objective measurement [Highest SFI] is [r = 0.61], [PNA: r^2 = 0.78]

- The correlation coefficient between Subjective evaluation [Purchase] and Objective measurement [Noise A-Weighted] is [r = -0.57], [PNA: r^2 = 0.78]

- The correlation coefficient between Subjective evaluation [Purchase] and Objective measurement [Highest SFI] is [r =- 0.57], [PNA: r^2 = 0.77]

- The correlation coefficient between Subjective evaluation [Interference] and Objective measurement [Signal to Highest SFI Ratio] is [r = -0.53], [PNA: r^2 = 0.72]

- The correlation coefficient between Subjective evaluation [Purchase] and Objective measurement [Signal to Highest SFI Ratio] is [r = 0.52], [PNA: r^2 = 0.71]

* [r = **] : Correlation coefficient of Draft

[PNA: r^2 = **] : Correlation coefficient based on data of Table 1 and 2.

Summarization of the correlation coefficient is in Table 3.

	subjective rating										objective measurement											
	Loudness		Pct Words		Interference		Us-ability		Purchase		AFI (1kHz)		A-Wtd Noise		Signal Quality		Highest SFI		Magnetic SFI		Signal / Highest SFI	
	Draft	PCC	Draft	PCC	Draft	PCC	Draft	PCC	Draft	PCC	Draft	PCC	Draft	PCC	Draft	PCC	Draft	PCC	Draft	PCC	Draft	PCC
Loudness	1		0.68		-0.45		-0.54		0.34	0.42	0.04		-0.2		0.21		-0.23		0.23		0.23	
Pct Words	0.68		1		-0.57		-0.73		0.44	0.79	-0.08		-0.32		0.27		-0.34		0.15		0.27	
Interference	-0.45		-0.57		1		0.77		-0.83	0.99	0.07		0.61	0.79	-0.56		0.61	0.78	-0.12	0.11	-0.53	0.72
Usability	-0.54		-0.73		0.77		1		-0.67	0.90	0.06		0.47		-0.42		0.48		-0.16		-0.41	
Purchase	0.34	0.42	0.44	0.79	-0.83	0.99	-0.67	0.90	1		-0.01		-0.57	0.78	0.55		-0.57	0.77	0.1	0.09	0.52	0.71
AFI (1kHz)	0.04		-0.08		0.07		0.06		-0.01		1		0.25		0.34		0.13		0.53		0.4	
A-Wtd Noise	-0.2		-0.32		0.61	0.79	0.47		-0.57	0.78	0.25		1		-0.83		0.98		-0.12		-0.78	
Signal Quality	0.21		0.27		-0.56		-0.42		0.55		0.34		-0.83		1		-0.88		0.42		0.99	
Highest SFI	-0.23		-0.34		0.61	0.78	0.48		-0.57	0.77	0.13		0.98		-0.88		1		-0.3		-0.85	
Magnetic SFI	0.23		0.15		-0.12	0.11	-0.16		0.1	0.09	0.53		-0.12		0.42		-0.3		1		0.56	
Signal /Highest SFI	0.23		0.27		-0.53	0.72	-0.41		0.52	0.71	0.4		-0.78		0.99		-0.85		0.56		1	

Table 3 Correlation

- There is a very strong correlation between [Interference] and [Purchase], we focus on [Interference] from here on forward.

- The correlation coefficient between Subjective evaluation [Interference] and Objective measurement [Noise A-Weighted] is [r = 0.61], [PNA: r^2 = 0.79]

- The correlation coefficient between Subjective evaluation [Interference] and Objective measurement [Highest SFI] is [r = 0.61], [PNA: r^2 = 0.78]

- The correlation coefficient between Subjective evaluation [Interference] and Objective measurement [Signal to Highest SFI Ratio] is [r = -0.53], [PNA: r^2 = 0.72]

Note:

([Highest SFI] and [Noise A-Weighted] are none defined Noise parameters)

We consider [Noise A-Weighted] for a second time focusing on the following viewpoints:

1. From the [Noise] point of view; the relation between Subjective evaluation [Interference] and Objective measurement [Noise A-Weighted].
2. The [Signal to Noise (S/N)] point of view; Subjective evaluation [Interference] and Objective measurement [Signal to Highest SFI Ratio].

- The correlation coefficient between Subjective evaluation [Interference] and Objective measurement [Noise A-Weighted]: [r = 0.61], [PNA: r^2 = 0.79] --- Fig. 1 (next page)

- The correlation coefficient between Subjective evaluation [Interference] and Objective measurement [Highest SFI]: [r = -0.53], [PNA: r^2 = 0.72] --- Fig. 2 (next page)

Comparing the both correlation coefficients between "r = 0.61 and -0.53"and "r^2 = 0.79 and 0.72", they are almost identical.

Fig. 1 (next page) show Noise A-Weighted vs. Interference and Fig. 2 (next page) shows Signal to Highest SFI Ration vs. Interference.

Note: * The lines in figures are approximate expression based on 9-plots.

X-axis is average value of Objective measurement in Table 2 and Y-axis is average value of Subjective evaluation Interference in Table 1.

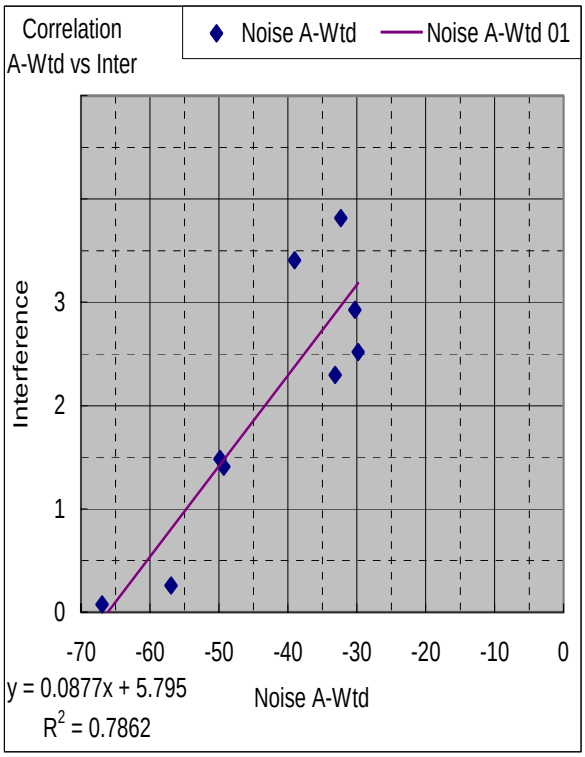

Fig 1: Noise A-Weighted vs. Interference

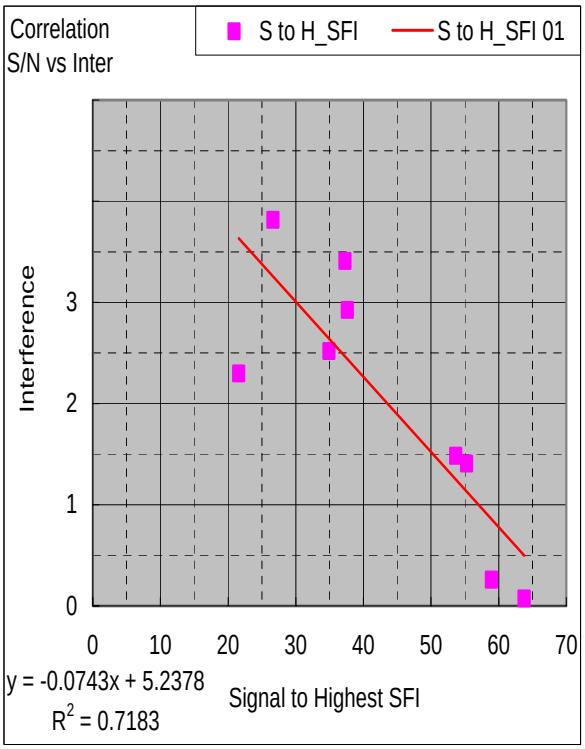

Fig 2: Signal to Highest SFI Ratio vs. Interference

Approximate expression (Formula 1) in Figure 1 is:

[Interference] = 0.0877*[Noise A-Weighted] + 5.795

Approximate expression (Formula 2) in Figure 2 is:

[Interference] = -0.0743*[Signal to Highest SFI Ratio] + 5.2378

Approximate expression (Formula 3) of this draft is:

[Interference] = 0.095*[Noise A-Weighted] + 6.0 -- Formula 3

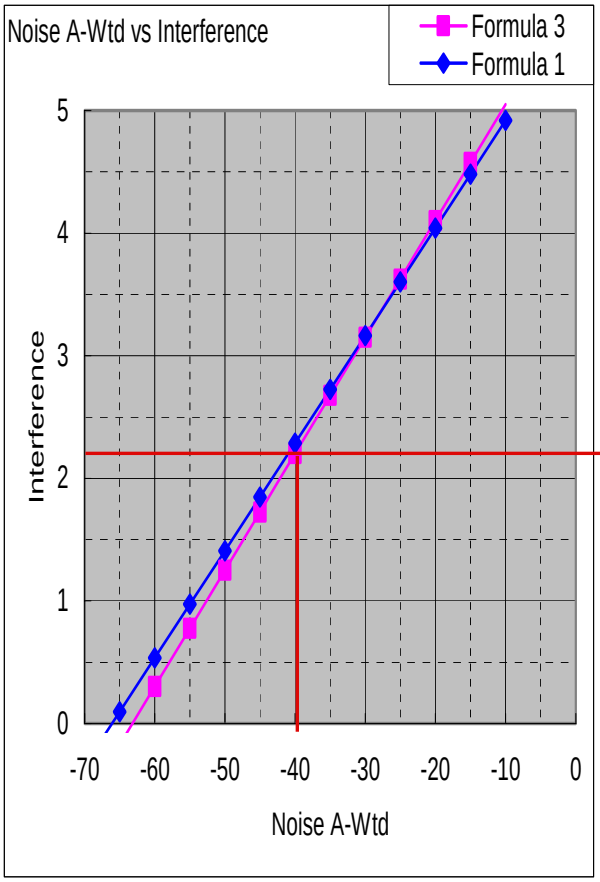

Fig.3: Noise A-Weighted vs. Interference (Approximation formula)

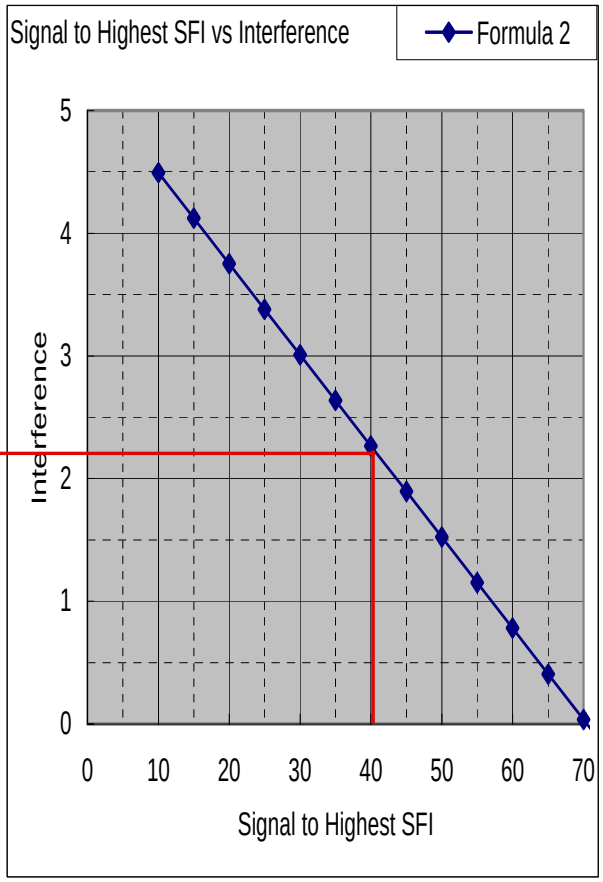

Fig.4: Signal to Highest SFI Ratio vs. Interference (Approximation formula)

In Fig. 3, we find that Formula 1 (PNA) and Formula 3 (Draft) are almost identical.

This means PNA derived the approximation formulas that come from Table 1 and Table 2 is adequate.

- Fig.3 shows that the point of -40dB (A/m) in Noise A-Weighted of X axis is 2.2 in Interference of Y axis.

- Fig.4 shows that the point of 2.2 in Interference of Y axis is 40 (dB) in Signal to Highest SFI Ratio of X axis.

In other words, [Signal to Highest SFI Ratio] > 40 dB will be the same as < -40 dB (A/m) [Noise A-Weighted].

In fact, both of [Noise A-Weighted] < -40 dB (A/m) in Fig 1 and [Signal to Highest SFI Ratio] > 40 dB in Fig 2 are the same results because 4 of 9 are OK and 5 of 9 are NG in both figures.

To confirm this conclusion, we change Y-axis of Fig.1 and Fig.2 from Subjective evaluation [Interference] to [Purchase].

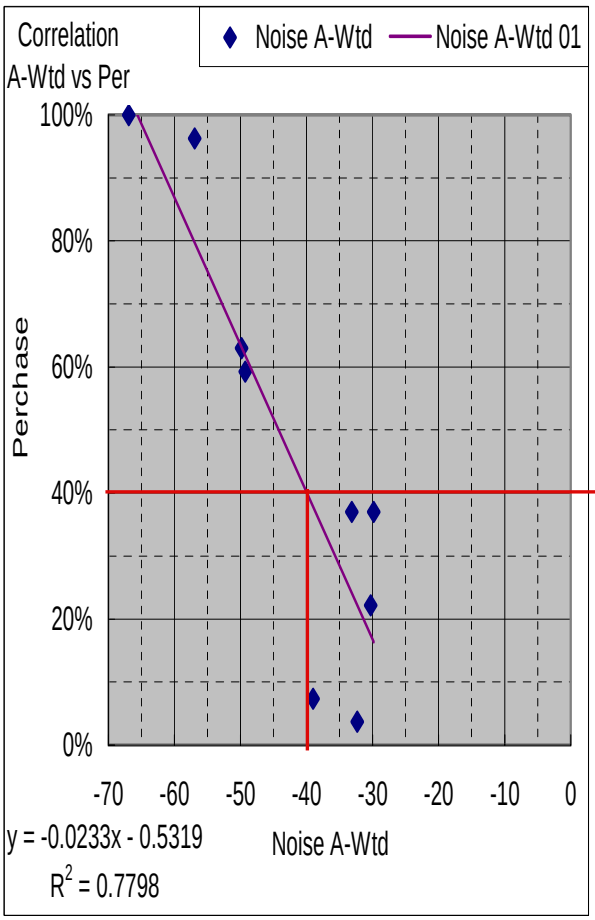

Fig.5: Noise A-Weighted vs. Purchase

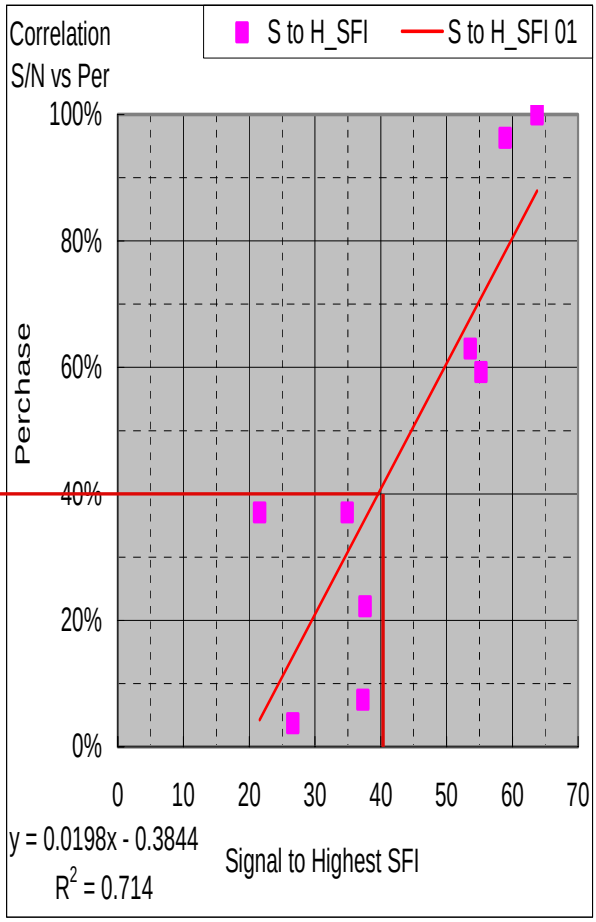

Fig.6: Signal to Highest SFI Ratio vs. Purchase

In Fig. 5, [Noise A-Weighted] < -40 dB (A/m) will be 40% of Subjective evaluation [Purchase].

In same way, [Signal to Highest SFI Ratio] > 40 dB will be about 40% Subjective evaluation [Purchase] In Fig.6.

Here again, both limits of > 40dB [Signal to Highest SFI Ratio] and <-40dB(A/m) [Noise A-Weighted] are the same of Objective measurement results

End of contribution